Remediation Technology Definitions

A

Air Sparging - The injection of air or oxygen through a contaminated aquifer or media to remove volatile and semivolatile organic contaminants by volatilization. Injected air traverses horizontally and vertically in channels through the soil column, creating an underground stripper.

B

Bacteria Assisted Phytoaccumulation - Process by which plant growth-promoting bacteria are used to protect plants from toxicity of contaminants.

Bacterial (Bioremediation) **-** Use of microorganisms to enhance biodegradation or removal of contaminants; through stimulation of naturally existing species or introduction of exogenous species to enhance biodegradation.

Bioaugmentation - Use of microorganism metabolism to remove contaminants from soils, water and other materials, through the introduction of indigenous or exogenous bacteria.

Biomining - Extraction of specific metals from their ores through biological means, usually bacteria.

Biosorption - is a physiochemical process that occurs naturally in certain biomass which allows it to passively concentrate and bind contaminants onto its cellular structure

Biostimulation - Addition of nutrients and oxygen to increase natural bacterial growth and stimulate contaminant degredation.

Bioventing - is an in-situ remediation technology that uses microorganisms to biodegrade organic constituents adsorbed on soils in the unsaturated zone. Bioventing enhances the activity of indigenous bacteria and simulates the natural in situ biodegradation of (typically) hydrocarbons in soil by inducing air or oxygen flow into the unsaturated zone and, if necessary, by adding nutrients.

E

Electrokinetics - Application of a low-intensity direct current through the soil between ceramic electrodes that are divided into a cathode array and an anode array, mobilizing charged species, causing ions and water to move toward the electrodes. Removal of contaminants at the electrode may be accomplished by electroplating at the electrode, precipitation or co-

precipitation at the electrode, pumping of water near the electrode, or complexing with ion exchange resins.

H

Hot Air/Steam Injection - Hot air or steam is introduced at high pressure through wells or soil fractures for deeper applications, and applied in combination with soil mixing or tilling, either in situ or ex situ, for shallower applications. As hot air/steam is injected through a series of wells within and around a source area, the steam zone grows radially around each injection well. The steam front drives the contamination to a system of vapor extraction wells in the vadose zone.

Hyperaccumulation/Phytoextraction - Involves contaminant uptake by plant roots, with subsequent accumulation in plant tissue. Plants that accumulate contaminants may require periodic harvesting and proper disposal to avoid recontaminating the soil when the plants die or drop their leaves.

I

Incineration - Incineration uses controlled-flame combustion to volatilize and destroy organic contaminants. Common incinerator designs include the rotary kiln, which can be used to treat a variety of waste forms, such as solids, liquids, sludges, and debris, and liquid injection systems which are used to treat aqueous and non-aqueous wastes that can be atomized through a burner nozzle. An air pollution control system (APCS) is used to treat off-gases from the combustion process.

In-Situ Flushing - Large volumes of water, at times supplemented with surfactants, cosolvents, or treatment compounds, are applied to the soil to raise the water table into the contaminated soil zone. Injected water and treatment agents are isolated within the underlying aquifer and recovered together with flushed contaminants.

In-Situ Oxidation - Chemical oxidation typically involves reduction/oxidation (redox) reactions that chemically convert hazardous compounds to nonhazardous or less toxic compounds that are more stable, less mobile, or inert. Redox reactions involve the transfer of electrons from one compound to another. The oxidizing agents most commonly used for treatment of hazardous contaminants in soil and groundwater are hydrogen peroxide, catalyzed hydrogen peroxide, potassium permanganate, sodium permanganate, sodium persulfate, and ozone.

In-Well Vapor Stripping - The creation of a groundwater circulation pattern and simultaneous aeration within the stripping well to volatilize VOCs from the circulating ground water. Air-lift pumping is used to lift ground water and strip it of contaminants. Contaminated vapors may be drawn off for aboveground treatment or released to the vadose zone for biodegradation.

M

Multi-Phase Extraction - Uses a vacuum system to remove various combinations of contaminated groundwater, separate-phase petroleum product, and vapors from the subsurface. The system lowers the water table around the well, exposing more of the formation. Contaminants in the newly exposed vadose zone are then accessible to vapor extraction. Once above ground, the extracted vapors or liquid-phase organics and ground water are separated and treated.

N

Nanotechnology – Use of nanoscale materials to remove contaminants from the subsurface. Nanoscales materials have dimensions between approximately 1 and 100 nanometers and can be highly reactive in part because of the large surface area to volume ratio and the presence of a larger number of reactive sites; but may also exhibit altered reaction rates that surface-area alone cannot account for. These properties allow for increased contact with contaminants, thereby resulting in rapid reduction of contaminant concentrations.

P

Permeable Reactive Barrier – In-situ method of remediating contaminated ground water that combines a passive chemical or biological treatment zone with subsurface fluid flow management.

Physical/Chemical - Physical/chemical treatments use the physical properties of the contaminants or the contaminated medium to destroy (i.e., chemically convert), separate, or contain the contamination.

Phytoaccumulator/Chelator - Use of chelators such as EDTA to improve the phytoaccumulation abilities of certain plants.

Phytoaccumulator/Chlorocomplexes - Use of salinity and chlorine forming metal complexes such as cadmium chloride as a means to improve the phytoaccumulation abilities of certain plants.

Phytochelatins - Process by which plants produce phytochelatins which is an enzymatically synthesized cysteine rich peptides to protect the plant from heavy metal toxicity.

Phytodegradation - The uptake of contaminants, which, through metabolic processes within the plant, are subsequently broken down. Phytodegradation also encompasses the breakdown of contaminants in the soil through the effects of enzymes and other compounds produced by plant tissues other than the roots.

Phytoremediation - Use of vegetation for contaminant removal and destruction in soil, sediment, surface water, and groundwater.

Pyrolysis - A chemical decomposition induced in organic materials by heat in the absence of oxygen. Pyrolysis typically occurs under pressure and at operating temperatures above 430ºC (800ºF) and the resulting gases require further treatment.

R

Radiofrequency or Microwave Heating - Uses electromagnetic energy to heat soil and enhance soil vapor extraction. The technique heats a discrete volume of soil using rows of vertical electrodes embedded in soil or other media. The technique can heat soils to over 300ºC.

Rhizoaccumulation - Process by which plant exudates stimulate rhizosphere bacteria to enhance biodegradation of soil contaminants; occurs in the soil directly surrounding the plant roots.

Rhizodegradation - "Plant-assisted bioremediation" in that the root zone enhances microbial activity, thus increasing the breakdown of organic contaminants in the soil. The rhizosphere extends only about 1 mm from each root.

S

Soil Vapor Extraction - A vacuum is applied to the soil to induce the controlled flow of air and remove volatile and some semivolatile organic contaminants from the soil.

Soil Washing - Contaminants sorbed onto fine soil particles are separated from bulk soil in a water-based system on the basis of particle size. The wash water may be augmented with a basic leaching agent, surfactant, or chelating agent or by adjustment of pH to help remove organics and heavy metals. Soils and wash water are mixed ex situ in a tank or other treatment unit.

Solvent Extraction - Uses an organic solvent as an extractant to separate organic and metal contaminants from soil. The organic solvent is mixed with contaminated soil in an extraction unit. The extracted solution is then passed through a separator, where the contaminants and extractant are separated from the soil.

Stress-Induced Phytoaccumulation - Use of plant stressors such as a micronutrient deficiency or acidic conditions to instigate phytoaccumulation in plants.

T

Thermal Blanket (ISTD) - Supplies heat to the soil through a blanket that covers the ground surface. As the polluted area is heated, the contaminants are destroyed or evaporated. The blanket is used where the polluted soil is shallow. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a treatment system.

Thermal Desorption - The application of heat to excavated wastes to volatilize organic contaminants and water. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a treatment system, such as a thermal oxidation or recovery unit.

Thermal - Ex-Situ - Destruction or removal of contaminants through exposure to high temperature in treatment cells, combustion chambers, or other means used to contain the contaminated media during the remediation process.

Thermal - In-Situ – Application of heat to polluted soil and/or groundwater in-situ to destroy or volatilize organic chemicals. As the chemicals change into gases, their mobility increases, and the gases can be extracted via collection wells for capture and cleanup in an ex-situ treatment unit. Heat can be introduced to the subsurface by electrical resistance heating, radio frequency heating, dynamic underground stripping, thermal conduction, or injection of hot water, hot air, or steam.

V

Vertical Thermal Well - Supplies heat to the soil through steel wells, which destroys or evaporates the contaminants. Steel wells are used when the polluted soil is deep. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a treatment system.

Vitrification - Uses an electric current to melt contaminated soil at elevated temperatures (2,900ºF to 3,650ºF). Upon cooling, the vitrification product is a chemically stable, leach-resistant, glass and crystalline material similar to obsidian or basalt rock.

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